First report of a totally ambicoloured Patagonian flounder *Paralichthys patagonicus* (Paralichthyidae) with dorsal fin anomalies

by

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RÉSUMÉ. - Premier signalement d'un *Paralichthys patagonicus* totalement ambicoloré, avec des anomalies de la nageoire dorsale.

L'exemplaire, capturé dans les eaux des côtes d'Argentine au large de Necochea (38°37'S-58°50'W), est entièrement ambicoloré, et présente aussi un développement anormal de la nageoire dorsale et une migration incomplète de l'œil droit. Il s'agit ici du troisième signalement du phénomène d'ambicoloration chez une espèce de *Paralichthys* dans l'Atlantique sud-ouest.

Key words. - Paralichthyidae - *Paralichthys patagonicus* - ASW - Argentine coast - Ambicoloration - Head anomalies.

A typical anomaly of flatfishes is malpigmentation, which is characterized by either a deficiency of pigment cells on portions of the ocular side (albinism, pesudoalbinism, or hypomelanism), or the presence of dark pigmentation on the normally light-coloured underside of the fish, also called ambicoloration (Bolker and Hill, 2000).

In May 2003, one totally ambicoloured and anomalous specimen of the Patagonian flounder *Paralichthys patagonicus* Jordan, in Jordan and Goss, 1889 was caught by a commercial bottom-trawler off Necochea (38°37'S-58°50'W), Argentina, at 31 m depth. *Paralichthys patagonicus* is one of seven paralichthyid flounders known from southwestern Atlantic waters (Díaz de Astarloa, 1994). This moderate to large-sized flounder (females to ca. 640 mm in standard length [SL]) is a common inhabitant in nearshore and offshore waters of northern Argentina (38°-41°S), and is the most economically important paralichthyid flounder in the southwest Atlantic (Díaz de Astarloa, 2002).

The specimen was identified, measured to the nearest 1 mm SL with an ichthyometre and a calliper, photographed with a Nikon Coolpix 4500 digital camera, fixed in 10% buffered formalin, preserved in 75% industrial ethylated spirit and housed in the fish collection of the Instituto Nacional de Investigación y Desarrollo Pesquero as INIDEP 726. The aberrant specimen was x-rayed to determine presence and extent of osteological abnormalities.

Counts and measurements were made on the wholly ambicoloured specimen for comparison with those of normal coloration. The only unusual measurement noted for this specimen was a much larger predorsal length. Otherwise, counts and morphometric features were well within ranges recorded for the species (Díaz de Astarloa, 1994).

RESULTS

The flatfish has the typical pigmentation developed on the ocular side characteristic for the species. It differs from other specimens in that it is also virtually totally pigmented on the blind side (Fig. 1A). The entire blind (right) side is uniformly dark brown,

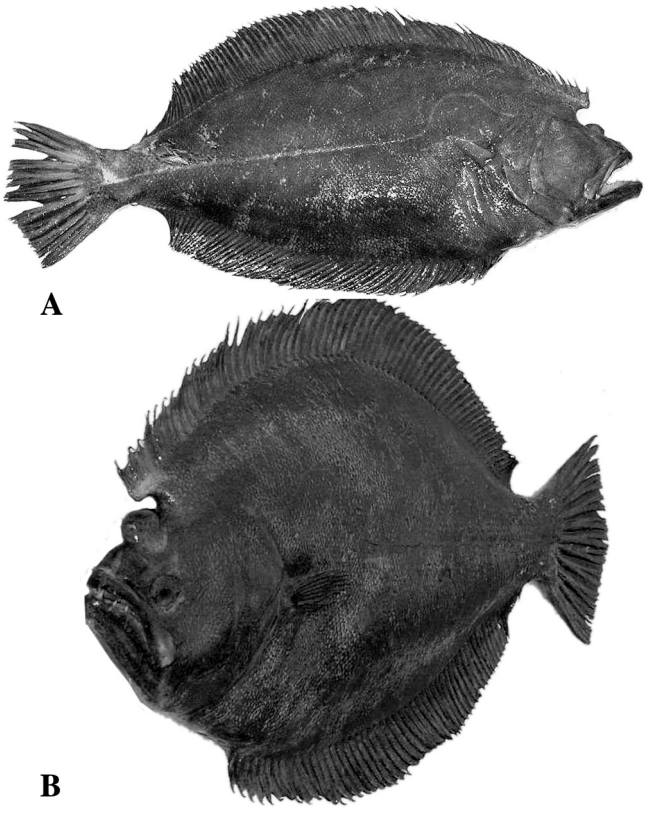

Figure 1. - Totally ambicoloured Patagonian flounder, *Paralichthys patagonicus*, 334 mm SL, taken off Necochea, Argentina. **A**: Blind side; **B**: Ocular side. (Photograph by M. R. Rico). *[Cardeau patagonien,* Paralichthys patagonicus*, entièrement ambicoloré, capturé au large de Necochea, Argentine. **A** : Face aveugle ; **B** : Face oculée.]*

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except for a triangle-shaped unpigmented patch near the base of caudal-fin rays, but otherwise its coloration resembles that of the ocular (left) side.

Externally, obvious morphological deformity is evident in the cranial region of the head. The Patagonian flounder has an anomalous development of a fleshy hook at the anterior end of the dorsal fin and it also features incomplete migration of the right eye. Instead of being situated on the medial region of the head, as it is typical for other specimens, the right eye of this specimen migrated only as far as the dorsal crest under the fleshy hook formed as a result of the obstructed forward growth of the dorsal fin. In this position it is visible from the right side (Fig. 1A), which is not typical of this species. Additionally, unlike normal specimens in which predorsal length (snout to dorsal fin origin) ranges from 3.4-6.5% SL, in this totally ambicoloured specimen the predorsal length is much longer (10.3% in SL). Further differences are that the blind-side skin resembles in some aspects that normally seen on the ocular side. In non-ambicoloured specimens the ocular-side scales are ctenoid and those on the blind side are cycloid. The posterior part of the ocular-side maxilla is covered by scales, while that on the blind side is scaleless. The anus opens on the blind side and the urogenital papilla is located on the ocular side forward and dorsal to the first anal fin ray. In contrast, the ambicoloured specimen has distinctly ctenoid scales on the blind side, the anus opens on the ocular side, slightly above the anal fin origin, while the urogenital papilla is located on the blind side, and the posterior part of the maxilla is scaly.

Examination of a radiograph of this specimen (Fig. 2A) clearly shows the incomplete development of the dorsal fin over the skull. Whereas in normal specimens (Fig. 2B) the dorsal fin origin develops over the anteriormost part of the neurocranium, in the totally ambicoloured specimen, the dorsal fin origin appears only over the posterior third of the neurocranium, near the occipital region (Fig. 2A). This abnormal position is reflected in the much larger predorsal length of this specimen compared to that of non-anomalous specimens. In the anomalous specimen there is also a vertical process developed in the middle part of the skull (Fig. 2A). This process appears to support the fleshy hook of the dorsal fin.

DISCUSSION

Flatfish specimens have been recorded as being total (Gudger, 1941, Haaker and Lane, 1973), almost total (Gudger and Firth, 1935; Gudger, 1936; Forrester and Smith, 1971; Fujita, 1980; Díaz de Astarloa, 1995, 1998), or partially ambicoloured (Gudger and Firth, 1936; Okiyama and Tomi, 1970; Wilkens and Lewis, 1971; Love and Vucci, 1973; Taylor *et al*., 1973; Stickney and White, 1975; Díaz de Astarloa, 1995). Previous reports of ambicoloured flatfishes are those of species occurring mainly in northwestern Atlantic and eastern Pacific waters. Dawson (1962) recorded an incompletely ambicolorate specimen of *Paralichthys lethostigma* trawled in Calibogue Sound, South Carolina, and an almost total ambicoloured specimen of *Trinectes maculatus* collected in the estuary of the Caloosahatchee River, Florida. Six ocellated flounders, *Ancylopsetta quadrocellata*, with pigmented blind sides were taken in the lower Newport River estuary, North Carolina (Wilkens and Lewis, 1971). Other ambicoloured flatfishes are a partially ambicolorate fringed flounder, *Etropus crossotus*, captured from coastal waters of Georgia (Taylor *et al*., 1973), a totally ambicoloured specimen of *Paralichthys californicus* collected in Anaheim Bay, California (Haaker and Lane, 1973), and an almost completely ambicoloured specimen with skeletal anomalies of Petral sole, *Eopsetta jordani*, taken off the west coast of Vancouver Island (Forrester and Smith, 1971).

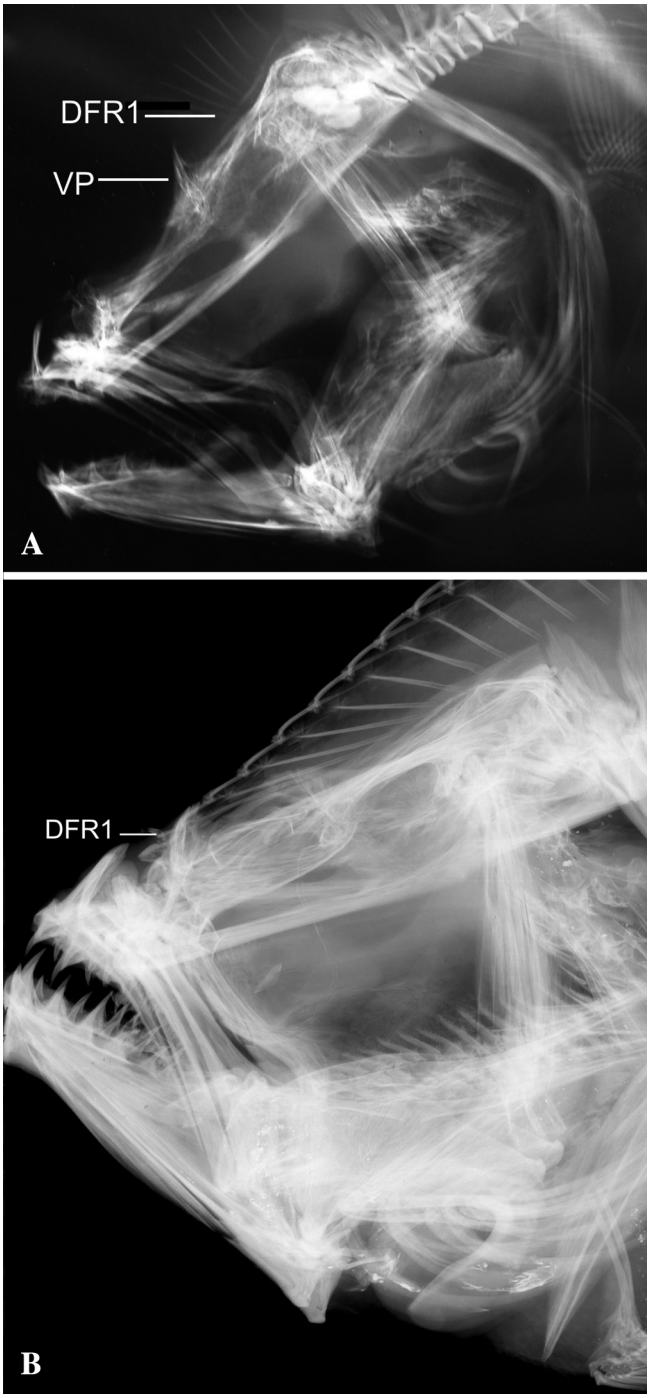

Figure 2. - **A**: Radiograph of head of aberrant *Paralichthys patagonicus* (334 mm SL) showing incomplete formation of dorsal fin. **B**: Radiograph of head of a normal *Paralichthys patagonicus* (405 mm SL). VP: vertical process; DFR1: first dorsal-fin ray. *[**A** : Radiographie de la tête d'un individu aberrant montrant la formation incomplète de la nageoire dorsale. **B** : Radiographie de la tête d'un individu normal. VP : processus vertical ; DFR1 : premier rayon de la nageoire dorsale.]*

Ambicoloration occurs frequently in hatchery-reared flatfish. Specimens with nearly 100% ambicoloration have been observed in tank cultured *Paralichthys dentatus* (L.) and *P. lethostigma* Jordan & Gilbert (Stickney and White, 1975), and 95% of hatchery-reared Japanese flounder (*Paralichthys olivaceus*) populations showed black areas on the underside of body (Tominaga and Watanabe, 1998). Houde (1971) found high abnormality frequencies (up to 84%) in laboratory-reared lined soles *Achirus lineatus*.

Blind-side pigmentation is uncommon in wild. Three California halibut specimens, *P. californicus*, from a total of 1,256 have been reported to have ambicoloration (Haaker and Lane, 1973), and although this defect has no pathogenic effect on the fish, chances of survival in the wild are greatly reduced (Koshiishi *et al*., 1991).

Frequencies of anomalies in various groups of flatfishes were thought to occur more frequently in less specialized flatfishes, such as paralichthyids and pleuronectids, and less frequently in more derived groups including the soleids and cynoglossids (Gartner, 1986). Whereas ambicoloration is well documented and apparently rather common in the Bothidae and Pleuronectidae, few records report such anomalies in the species of Achiridae, Soleidae and Cynoglossidae. Dawson (1962), summarizing results from the literature, listed 27 specimens of bothids and pleuronectids showing four types of ambicoloration, but noted only two cases of abnormal coloration in the other families including an almost completely ambicolorate *Trinectes maculatus* (Achiridae) and a partially ambicolorate *Symphurus plagiusa* (Cynoglossidae). The account (Gartner, 1986) of naturally occurring anomalies in *Gymnachirus melas* represents the first documented report for achirids in the western Atlantic other than *Trinectes maculatus*. Other cases of anomalous specimens of Achiridae and Cynoglossidae were documented by Moore and Posey (1974) and Munroe (1996), respectively.

For flatfishes where blind-side pigmentation is complete or almost complete, this coloration nearly always is associated with head or vertebral anomalies or some other variation in the morphology of the specimens, such as migration of the eye, scales and associated structures (Norman, 1934; Díaz de Astarloa, 1995, 1998). The mechanism of eye migration and cranial asymmetry in Pleuronectiformes has been explained by different hypotheses (Brewster, 1987), and it is not one mechanism for all flatfishes. For instance, in pleuronectids when the migrating eye has passed the dorsal mid-line of the cranium, the dorsal fin anterior proximal pterygiophores migrate anteriorly (Brewster, 1987). In scophthalmids, in turn, as the eyes begin to migrate, there is a simultaneous anterior migration of the dorsal fin proximal pterygiophores (Brewster, 1987). In normal flounders, eye migration is completed before the forward extension of the dorsal fin takes place, but in ambicolorate examples this migration appears to be arrested or delayed causing an obstructed normal growing of the dorsal fin and as a consequence a fleshy hook is formed above the eye (Norman, 1934; Haaker and Lane, 1973). This hook is present only where the pigmentation of the blind side is complete or nearly so (Norman, 1934). It is also possible that an interrupted fin growth interferes with eye migration. Further data, however, are required to fully support this hypothesis. Gudger and Firth (1936) offered an hypothesis to explain the conditions which the morphological anomalies occur. They found that when the blind side is completely coloured like the ocular side or when about one-fourth to one-third of the head surface of the blind side is coloured, then the rotating eye will not completely migrate and the dorsal fin will be hooked. Haaker and Lane (1973) reported a totally ambicolored *Paralichthys californicus* with abnormal position of the migrating eye and the formation of the anterior dorsal fin into a fleshy hook, and an almost totally ambicoloured *Hypsopsetta guttulata* with a depression formed in the frontal region of the head. Fujita (1980) found a reversed almost completely ambicolorate *Platichthys bicoloratus* (cited as *Kareius bicoloratus*) with a fleshy hook developed on the anterior edge of the dorsal fin.

The abnormal flatfish specimen reported in the present study represents the first documented occurrence of a totally ambicoloured *Paralichthys patagonicus* with an incomplete eye migration and hooked anterior dorsal fin, and the third record of ambicoloration in a species of *Paralichthys* occurring in southwestern Atlantic region.

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